

Nuclear Power's Prospects

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Country	Nuclear Capacity GW (plants)	Percent of Electric Production	Plants under construction
United States	98.5 (103)	20	0
France	63.8 (58)	79	0
Japan	46.5 (55)	34	2
Russia	21.2 (31)	15	4+
Germany	20.0 (17)	29	0
South Korea	17.9 (21)	40	3
Canada	15.2 (22)	13	0
Great Britain	12.3 (33)	22	0
China	6.7 (9)	2	4
India	3.0 (15)	3	7
World total <small>(IAEA, 8/05)</small>	368.1 (441)	16	24

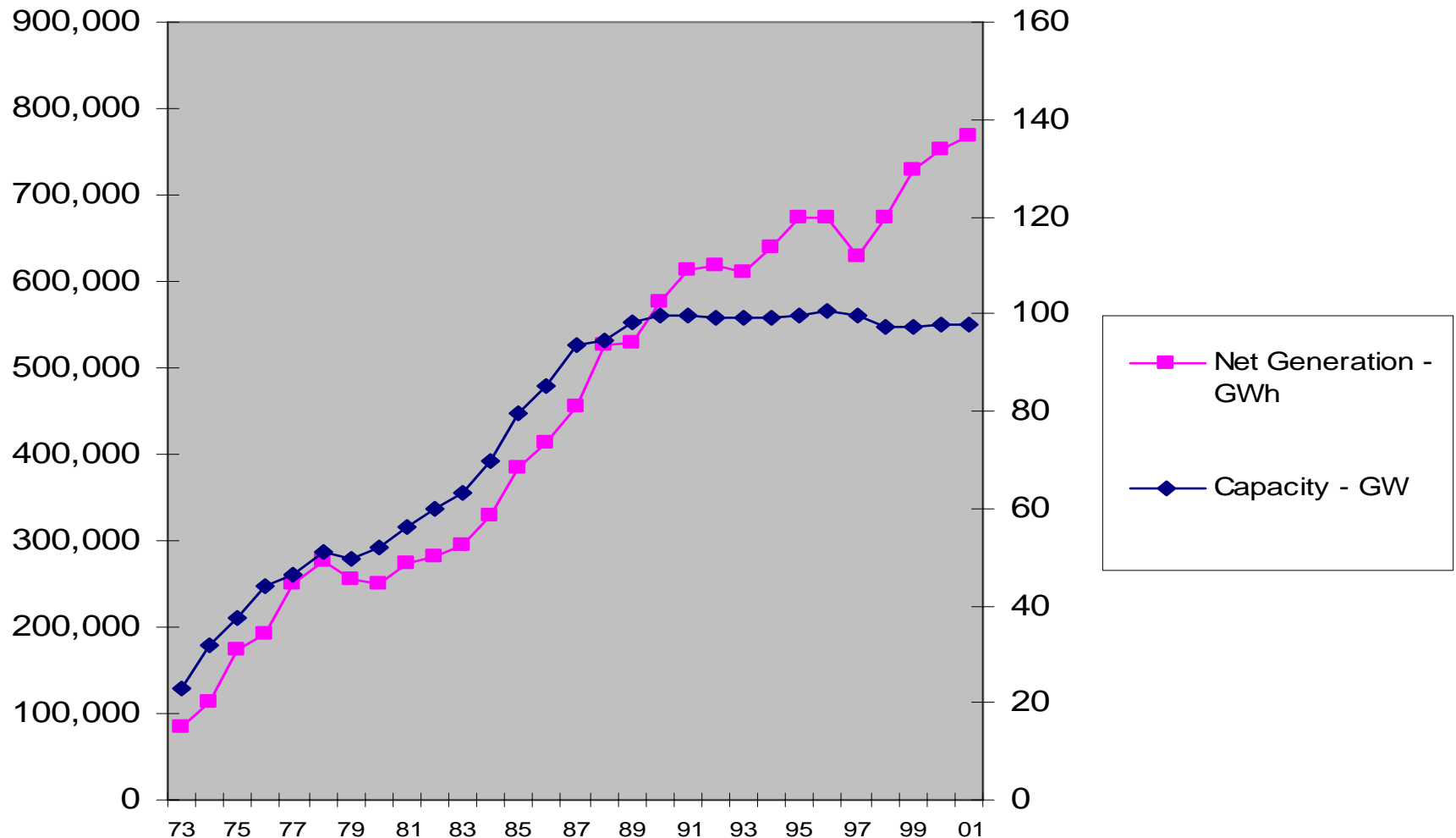
USDoE/EIA International Energy Outlook Forecasts

- Reference case – World electricity demand doubles over the next 20 years
- Nuclear power increases from 353 GW in 2001 to 385 in 2025.
 - But declines from 16% of generating capacity to 12%.
 - Most new construction is in Asia and Russia
 - China 19GW (Chinese say 28-30GW)
 - South Korea 15GW
 - Japan 11GW (retiring 5GW)
 - India 6GW
 - Russia 6GW (Russians say 40 GW by 2030) (retiring 7GW)

Status of U.S. Nuclear Power in 2004

- Economics greatly improved since the 1980s, but new plants not competitive
 - Existing plant operating costs under 2 cents/kWh
- Substantial industry consolidation
- Yucca Mountain waste repository approved by President and Congress but facing legal and technical problems
 - Dry cask storage has solved problems at plant sites
- License extensions likely for almost all plants
- Capacity increases
- Minimal public participation in the regulatory process
- Strong federal government support

U.S. Nuclear Output and Nuclear Capacity, 1973-2002: Productivity Improvement in the Face of Competition



Recent Issues for U.S. Nuclear Power

- Terrorism (fears and costs)
- Safety problems associated with aging power plant components
- NRC regulatory vigor
 - Davis Besse vessel head rust
 - Many other troublesome indications that the NRC is putting nuclear economic interests too high relative to safety and public confidence.

NRC Shortcomings (from PB written submission to CEC)

- The major challenge that the Commission faces is to become an independent force for nuclear safety and an agency in which employees do not fear reprisal for raising safety issues. To do that, it will have to stand apart from Congressional, administration and industry pressure. Its behavior, rather than merely its rhetoric, will have to put safety ahead of the economic interest of the nuclear industry. It has a long way to go.
- The NRC has in recent years fallen back into the mindset described in the post-Three Mile Island reports of the President's Commission and the NRC's own Special Inquiry Group as being a major contributor to the TMI accident. As the President's Commission put it, "We find that the NRC is so preoccupied with the licensing of plants that it has not given primary consideration to overall safety issues.....With its present organization, staff and attitudes, the NRC is unable to fulfill its responsibility for providing an acceptable level of safety for nuclear power plants".^[1]
- Were another accident to occur tomorrow, the subsequent investigators would hardly have to change a word of these findings.

^[1] Report of the President's Commission on the Accident at Three Mile Island: The Need for Change, October, 1979, pp. 51, 56.

NRC Shortcomings II

- **Here is a partial bill of particulars (assembled from memory of events in the last few years – research would produce much more) that such a review would consider in reaching this conclusion in 2005:**
 - **The near accident at Davis-Besse in 2002, in which the NRC allowed the economic interests of the plant owner to override a staff recommendation that the plant be shut down to inspect the reactor vessel head;**
 - **The 2002 internal NRC survey showing that almost half of all NRC employees thought that their careers would suffer if they raised safety concerns and nearly one-third of those who had raised safety concerns felt they had suffered harassment and/or intimidation as a result. The then chair of the NRC said that this survey was good news because the 2000 survey had shown that 60% of all employees had feared that raising safety issues would hurt their careers;**
 - **The unfounded NRC claim immediately after the September 11, 2001 attacks that nuclear power plants were designed to withstand such plane crashes, later withdrawn;**
 - **The systematic reduction of opportunities for public participation, including rejection of intervenor group efforts to raise potential terrorism as an issue in licensing proceedings since September 11, 2001 on the grounds that terrorism at the facility in question was “too speculative”. The staff position to this effect was submitted to the licensing board on September 12, 2001.**

NRC Shortcomings III

- An unprecedented commissioner speech attacking an intervenor group with a long history of responsible involvement in NRC proceedings;
- Repeat decisions by the Commission to recommend for the highest possible federal bonus the employee who had been primarily responsible for the mistakes at Davis-Besse, an employee who – during the same time period – had been found by the NRC Inspector-General to have knowingly inserted a false statement in a letter by the NRC Chair;
- The ongoing effort by the NRC to make a relatively low ranking First Energy employee the sole individual sanctioned for the many failings at Davis Besse.
- Statements made in China by the NRC Chair promising that a license would be issued to a pending reactor design application by Westinghouse;
- The claim by Senator Pete Domenici that he had successfully persuaded the NRC to reverse its “adversarial attitude” toward the nuclear industry by threatening to cut its budget by one-third in a 1998 meeting with the Chair.[\[2\]](#)

[\[2\]](#) Senator Pete V. Domenici, A Brighter Tomorrow: Fulfilling the Promise of Nuclear Energy, (Rowman & Littlefield, 1998), pp. 74-75.

Current National Policy

- “The NEPD group recommends that the President support the expansion of nuclear energy in the U.S. as a major component of our National Energy Policy.” (Cheney Report, 2001)
- Administration and Congressional support in 2005 energy legislation
 - Loan guarantees
 - Tax credits
 - “Insurance”

Nuclear Power and Competitive Markets

- U.S. generating markets open to competition since 1980;
 - Competitive bidding since mid1980s in many states
 - In New York in 1990-91, bids from existing nuclear plants lost out to new gas plants
 - Integrated resource planning in other states
- Retail competition since mid1990s in many states
 - Compelled large cost reductions
 - Revealed stranded costs, mostly in nuclear plants

Nuclear Power and Competitive Markets II

- Risk now on investors, who have been unwilling to accept it.
 - Nuclear provisions of recent law are largely an effort to move risk from investors to taxpayers in order to get new orders.
 - California PUC may move in the same direction in having customers finance steam generator tube replacement.

The U.S. Nuclear Cost Problem – MIT Study, August 2003

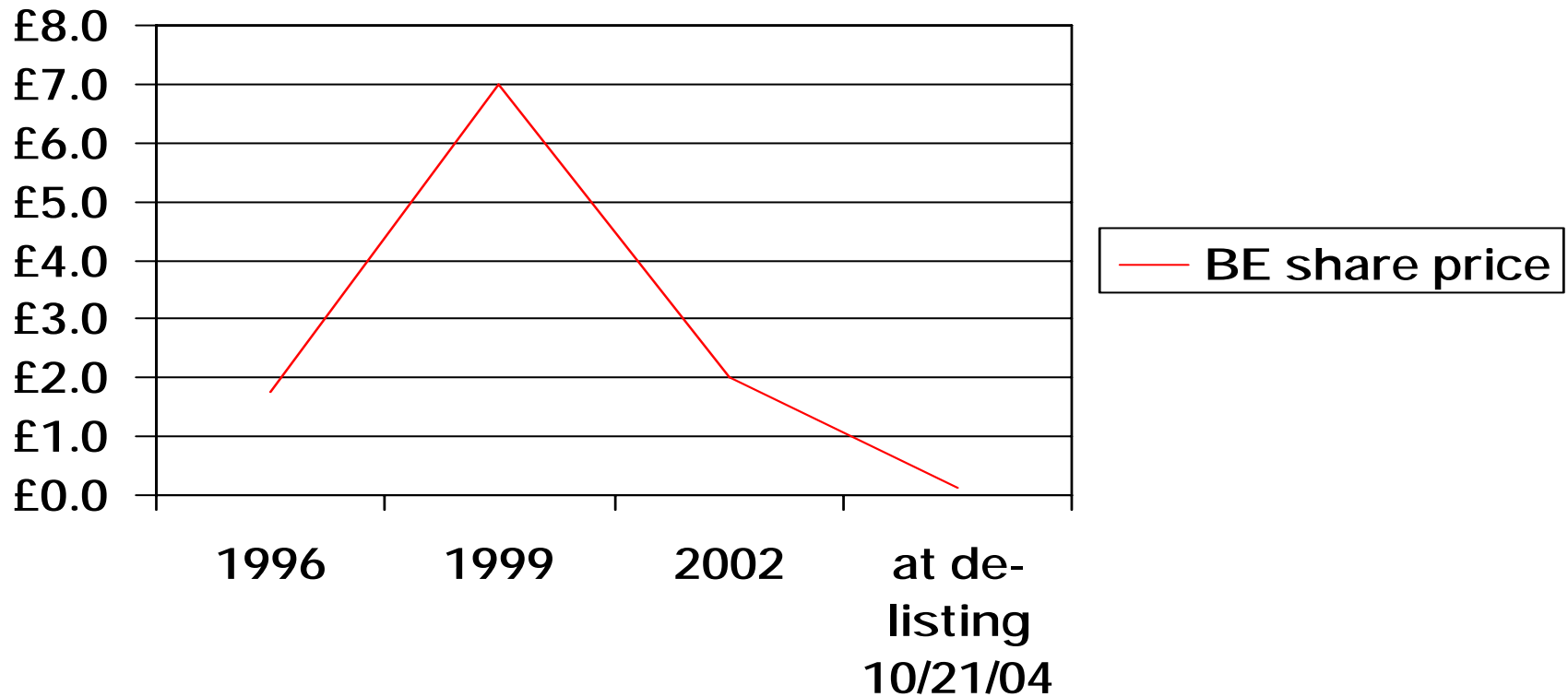
• BASE CASE	REAL LEVELIZED COST
• (Year 2002 \$)	Cents/kWe-hr
• Nuclear (LWR)	6.7
•	
• Pulverized Coal	4.2
• CCGTa(low gas prices, \$3.77/MCF)	3.8
• CCGT (moderate gas prices, \$4.42/MCF)	4.1
• CCGT (high gas prices, \$6.72/MCF)	5.6
• a. Gas costs reflect real, levelized acquisition cost per thousand cubic feet (MCF) over the economic life of the project. U.S. gas prices in late 2004 are above the high case but are expected to decline into the moderate case range in the longer term.	

MIT Study, 8/03

British Experience Combining Nuclear Power with Competitive Markets Basically Confirms that of the U.S.

- In 1989 British government believed that new nuclear units would prevail over expensive domestic coal once generating sector was privatized and open to competition;
 - But nuclear units had to be withdrawn from privatization at the last moment
 - And new gas-fired plants won all of the competitive solicitations
 - 1996 privatization of British Energy (the 7 newest nuclear units) revealed diseconomies of British fuel cycle and nuclear capital costs
 - British government aid to British Energy shifts above market costs to taxpayers just as U.S. stranded cost recovery decision shifted excessive capital costs to customers.

British Energy's shareholders absorbed pain that their U.S. counterparts avoided, probably because they invested under competition



Spent Fuel Costs, British Energy v. U.S.

- British Energy paid about \$8/mWh for reprocessing services
- U.S. utilities pay about \$1/mWh for long term disposal, plus costs of onsite storage.
- Such excess costs simply cannot be maintained in competitive generation markets.
- Reprocessing is not getting cheaper, so any improvement in its relative position means uranium and/or enrichment costs are rising – bad news for nuclear power's competitive position.

MIT Study on Future of Nuclear Power, August 2003

“The nuclear power option will only be exercised, however, if the technology demonstrates

- better economics,
- improved safety,
- successful waste management,
- low proliferation risk,
- and if public policies place a significant value on electricity production that does not produce CO₂”

Implications of Climate Change Policy

- According to the 2003 MIT study, a carbon tax of \$50/ton would be consistent with reducing U.S. emissions by 1 billion tons/year.
 - At this level, nuclear is only competitive if it achieves other substantial cost reductions.
- At carbon taxes in the \$100-200/ton range, new nuclear plants become competitive with conventional fossil fuels.
 - However, in a fully functional market, nuclear would have to compete successfully with energy efficiency, with renewables and with carbon sequestration technologies
 - Historically and probably well into the future, each billion dollars spent on energy efficiency buys more greenhouse gas mitigation (and other benefits) than would nuclear power.

Sensible Energy Policy that Might Improve Nuclear Power Prospects and Command Broad Political Support

- Implement climate change policy that creates (or recognizes) value of all carbon reducing technologies, including carbon sequestration, energy efficiency and renewable energy
- Use neutral market mechanisms to choose least costly approaches among these
 - Carbon caps and markets
 - Carbon taxes
 - Carbon reducing set asides (portfolio standards) and/or production tax credits
 - Evenhanded research support
 - Remove liability limitations for future projects

Some Competitors under a CO₂ Averse Policy

The 15 Pacala-Socolow wedges

- Efficiency in vehicles, buildings, vehicle use.
- Substitution of gas for coal
- CO₂ capture
- Renewables
- Biomass and reduced deforestation
- Nuclear power

Energy Policies That Might Appear to Favor Nuclear Power But That Are Inconsistent with Market Economics and/or Democratic Governance

- Governmental Favoritism, including
 - Tax credits, loan guarantees and risk insurance solely for new nuclear plant output
 - A disproportionate program of research and other grants
 - Efforts to further streamline a licensing process that has been continuously cut back for 25 years
 - Extension of liability limitations to new nuclear power plants
 - A heavy handed waste repository licensing process
 - Governmental efforts to revive reprocessing, suspended by Presidents Ford and Carter.

The Paradox of Strong Political Support for Nuclear Power

- 1981 – President Reagan’s election caused the head of the Atomic Industrial Forum to announce an industry reaction “half way between ecstasy and euphoria”
 - Pronuclear appointments at NRC and DoE
 - Support for reprocessing and breeder reactors
 - Nuclear Waste Policy Act of 1982, promising a 1998 “solution”
- Result: About 50% of Ralph Nader’s nuclear agenda was achieved in the next eight years
 - No new applications for nuclear power plant licenses
 - More plants cancelled than completed, including the only breeder reactor
 - No commercial interest in reprocessing
 - Second repository search an embarrassing failure, delaying the first one.
 - AIF goes under. Midpoint between ecstasy and euphoria turns out to be unemployment.

Is the Paradox Just Coincidence?

- Pressure of strong political support on the quality of decisionmaking (compared to the quiet times in the 1990s – Bush I and Clinton)
 - Very difficult to admit and learn from mistakes in such an environment
- Emerging reliance on markets to make power supply decisions seems to trump political support
- A similarly paradoxical history appears during the Project Independence push in the 1970s
- Those who see the present climate as a return to nuclear boosterism should ask whether this is really good news for nuclear power.

A Return to an Era of Strong Federal Promotion?

- 1972 forecast of 1000 nuclear plants by 2000
- About 30% of world nuclear capacity
 - No new plants ordered since 1978
 - None started after 1973 were completed
 - More plants canceled than completed
- Is it the licensing process?
 - Licensed more plants than next four countries combined pre1978
 - Process streamlined greatly since 1980
 - Vehemently pronuclear federal environment most of the last 25 years

Nuclear Power Today

- Growing where
 - Access to gas is limited and/or
 - Competitive generation markets for new power plants are limited or nonexistent (or a de facto nuclear quota exists) and/or
 - Governments are given to centralized energy planning

The Implications of Competitive Power Supply

- No nation has chosen a new nuclear plant through an open and transparent competitive procurement process
 - Competition policy and buyer choices matter more; regulatory policy and government preference matter less.
- Private investors saw TMI transformed from a \$2 billion asset to a \$ 1 billion clean up job in about ninety minutes.
 - Capital cost estimates and construction times for all alternatives more certain and smaller
 - All alternatives to nuclear provide more flexibility, less uncertainty.
 - Nuclear units under construction are especially vulnerable to cost escalation caused by an accident elsewhere.
 - Favorable economics of new plants don't apply until several have been built
- The high costs of reprocessing are inconsistent with competitive markets.

Nuclear v. Fossil Economics

- Temporary fossil fuel price spikes (even those lasting several years (such as late 1970s) however politically unsettling, provide no basis for private financing of nuclear power;
- In most countries, nuclear power cannot displace oil imports because imported oil generates little electricity
 - But nuclear power could – at the right price - displace some natural gas, which could displace some imported oil.

Some Conclusions

- US power supply choices will be made through competitive processes. At least until climate change costs are internalized, this will not favor new nuclear power plants, though it may favor license extensions.
- New nuclear power today cannot compete with fossil fuels. It is therefore under constant pressure to resist cost increases of any kind, including for safety.
- Strong political support – governmental picking of a technology winner - has done nuclear power more harm than good in the U.S.

Some Conclusions II

- Climate change will force increased reliance on nonfossil sources. But nuclear power has serious competitors –per the Pacala/Socolow “wedges” - some of which have won out before.
- California will be better served by market neutral policies and plans than by trying to play pin-the-tail on the donkey with particular energy sources.